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HAWAII AGRICULTURAL EXPERIMENT STATION, HONOLULU.

J. G. SMITH SPECIAL AGENT IN CHARGE.

PRESS BULLETIN No 6.

To acquaint the public with what is necessary to be known in regard to the cultivation of vanilla in Hawaii the following paper has been prepared by Mr. Frank E. Conter. This is in part a record of observations made on plants grown here, and in part a compilation from the best works on Vanilla culture, especially Lecomte and Chalot, "Le Vanillier;" Galbraith, "Vanilla Culture;" and, Dr. Preuss, "Expedetion nach Central und Sud-Amerika."

Experiments in curing vanilla were made at this Station, using pods from plants grown by Hon. S. M. Damon at Moanalua. Mr. Conter has also visited the Edwards Vanilla Plantation on Hawaii, and has noted the conditions there, and in the numerous localities around Honolulu where this plant is making a thrifty growth.

The vanilla plant was introduced into Hawaii many years ago, direct from Mexico and also from Tahiti, Samoa and Fiji. The prime requisites to make the cultivation of this crop a success are: the selection of a suitable location, at low elevation and where there is protection from the full sweep of the trade winds; and, of even greater importance, constant and careful attention to every detail of cultivation, pollination, curing and fermentation, until the selected and finished product is ready for market. The sole difference between a crop of vanilla at $1 a pound and one at $10 to $15 is the care given to the crop from the time the cuttings are planted until the finished product is marketed.

JARED G. SMITH,
Special Agent in Charge.

Honolulu, Aug. 10, 1903.

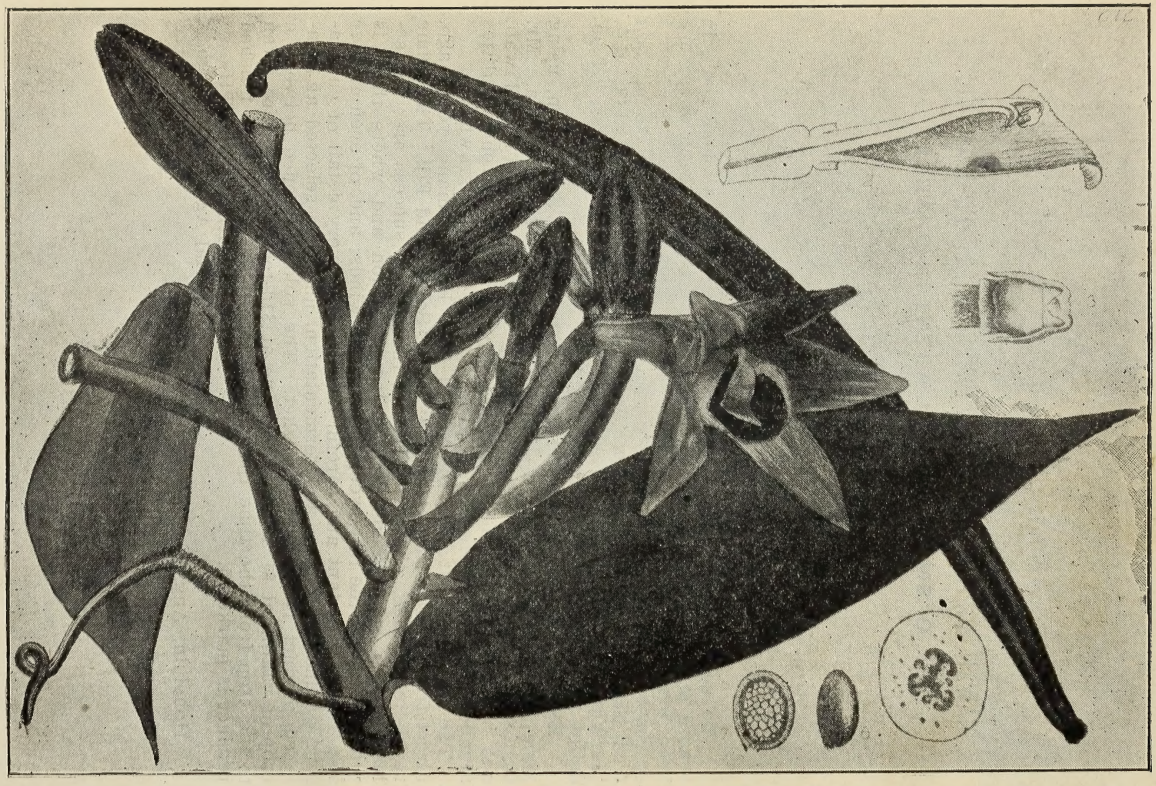

Plate I: Vanilla flower cluster and ripe pod, 5-7 natural size. (After Bentley and Trimen).

VANILLA CULTIVATION IN HAWAII.

The vanilla bean is the cured fruit of a vine belonging to the orchid family. The term "bean" is a misnomer, as the plant is not a legume. The elongated fruit pods are from five to eight inches long and the size of a lead pencil. They are black, glossy and somewhat wrinkled on the surface and contain thousands of exceedingly minute black seeds.

The vanilla plant is a native of Mexico (Pl. I). In 1808 Andrews gave the name *Vanilla planifolia* to the best varietty, known there as mansa o fina. Today this plant is found wild in the light forests of Southeast Mexico, Peru and on Luzon, Philippine Islands. It is also extensively cultivated in the province of Vera Cruz, Mexico, and on the islands of Reunion, Madagascar, Mauritius, Java, Fiji, Tahiti and the Seychelles. The plant is a fleshy dark-green perennial climber, adhering to trees by its aerial roots. In a vanilla plantation these trees are called supports. The vine attains the thickness of a finger and grows singly for a considerable height. When nipped or bent over a number of shoots are thrown out, which bear flower-clusters, each yielding ten or more flowers. The flowers open about five weeks after they burst through the buds. The pods grow to their full size in five weeks, and mature in about seven months.

Temperature. It may be stated in a general way that the vanilla plant requires a mean temperature of 77° F. and abundant rains during two-thirds or three-fourths of the year. The production is more abundant and of better quality in countries having a distinct dry season. The humidity should be about 75° and the soil always moist. The temperature must not be subject to sudden changes and should not go too high and never below 49° F.

Soil. Any soil is suitable, provided the drainage is good. Light soil and porous subsoil should be given the preference. The best locations are valleys with slight slopes, where a moist atmosphere and protection from strong wind may be obtained. Forest land or land which has been covered with a dense growth of lantana should be selected. The decaying leaves and later the decaying branches and trunks will furnish the necessary humus.

The Plantation. Clear the land by means of brush hooks and cane knives and dig out guava roots. Cut down all large trees not wanted for wind-breaks, and cut up the large branches. Trees having a diameter of less than six inches are left standing. Next lay out the fields and set out additional trees for wind-breaks. It must be well understood that a vanilla plantation needs protection from strong wind. It is not sufficient to protect from prevailing winds only, but the field must be protected in all directions. Trees must not only be planted around a large plantation, but lines of trees should be set at intervals thrugh the fields. The lines for the supports may then be marked by stakes. These lines should be 8 feet apart and the trees planted at intervals of from 6 to 8 feet. Low growing trees which do not shed their bark, should be selected for supports. The following are

recommended for Hawaii: *Spondias lutea*, (Hog plum); *Erythrina lithosperma*, (Coral tree); *Crescentia*, (Calabash tree); *Bauhinia tomentosa*, (St. Thomas' tree), together with the small trees which have been left standing, provided they are nearly in line. All others should be cut out unless wanted for wind-breaks or shade.

Choice of cuttings. The method of propagation is by cuttings. The shipment of plants is made during the dry season, when growth has been checked. The plants are pulled up from the ground and the roots are freed from soil. The plants may be wrapped in paper or packed in moss. A part of the plantation should be reserved for a nursery, in which the plants are left to grow vigorously, without exhausting them by fructification. This is the best method to obtain strong cuttings, to prevent the plants from degenerating and to guard against diseases. Only those parts of the plants should be used for cuttings that have short joints, as such cuttings will form most roots on a given length. Cuttings giving the best results are obtained from laterals. The joints are short and the terminal bud continues growing. Cuttings of from 3 to 6 joints may be used. Long cuttings may produce flowers 18 months after planting, while with short cuttings abundant flowers cannot be expected before the third year.

Planting. The best time to set out the cuttings is probably the early autumn, but it may be done at any time of the year. The longer the cutting the more should be put in the ground. One joint when the cutting has three, two when four, and even four or five when long cuttings are used. The leaves should be cut from that part of the cutting put into the ground, care being taken not to injure the aerial roots. Cuttings should be placed horizontally and buried 3 inches deep. The exposed end is fastened so that the aerial roots are close to the bark of the supporting tree. The fastener may be raphia or any other band. No string should be used. Should dry weather follow the planting, it would be advisable to water the plants. In Mexico cuttings 2 feet 6 inches long are made eight days before planting. Some planters use cuttings 3 feet 6 inches long, bury 1 foot 1 inch deep and cover with leaves and grass. Covering is necessary during dry, warm weather to protect the rootlets, which are close to the surface and would be killed by the sun.

Cultivation. The trees used as supports should be pruned in the late fall. Vanilla requires some sunshine, and when growing in shaded places, bears but few flowers and the fruit does not mature so well. In sunny places, however, the vines suffer, because the surface of the support may become so dry and overheated as to destroy the aerial roots. Some cuttings always remain dwarfed. These should be replaced as soon as practicable. The vine is allowed to grow 2 or 3 feet above the forked branches of its support. This upper portion should be carefully separated and hung loosely over the forks of the supporting tree, making pollination and harvesting possible without the use of ladders. Branches from 2 to 4 feet long, inclining downwards, produce the most flowers. To encourage this growth, the vines are pinched off near the end and thus a thick growth, completely covering the branches of the tree, is obtained. The vanilla plant begins to bear during the third year and continues until 7 or 8 years old. When flowering and maturing fruit, the plants should have a dressing of decomposed leaves, grass or banana leaves and trunks. Stable manure should not be used, unless put into trenches, where the roots will reach it when well decomposed.

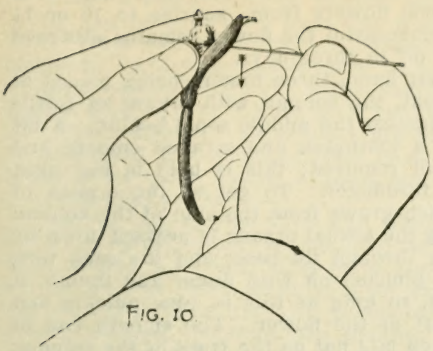

FIG. 10

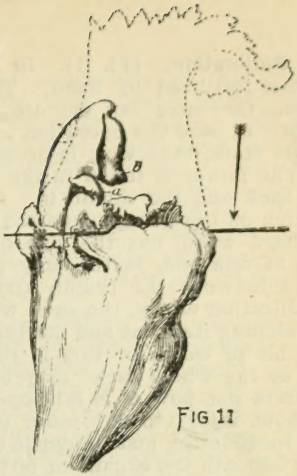

FIG 11

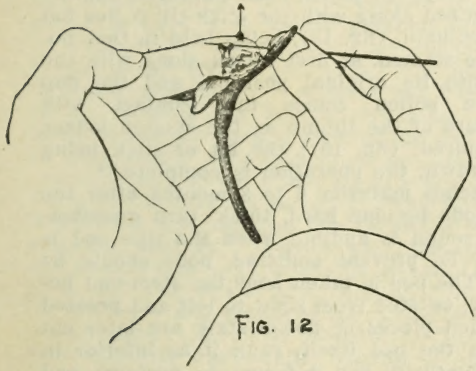

FIG. 12

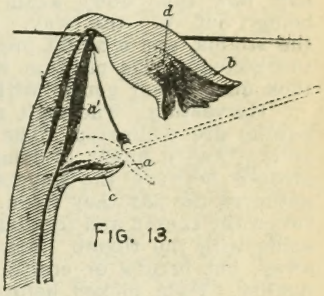

FIG. 13.

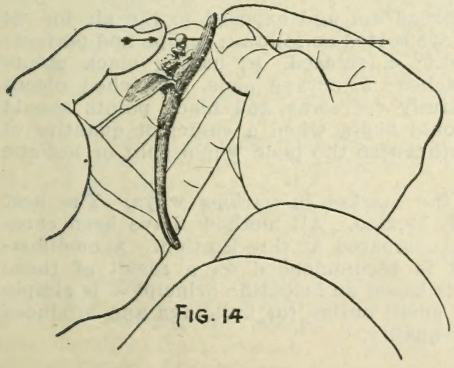

FIG. 14

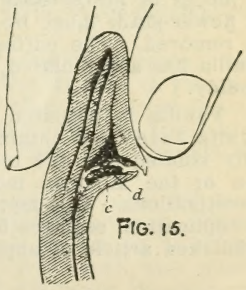

FIG. 15.

Plate II. Method of hand pollinating Vanilla flowers. (After Lecomte).

Pollination. (Pl. II). In Hawaii the flowers do not produce fruit unless fertilized by hand. This must be done the morning they open. One man can operate 1000 flowers from sunrise to 10 or 11 A. M. In case the operation is successful the flower remains attached to its stalk, otherwise it drops off in three days.

"The flower is taken in the left hand, three fingers being placed at its back and the thumb in front, the column with organs of fertilization on top being supported against the middle sepal behind. A bit of hard wood, cut the size of a toothpick and scraped smooth and flat at one end, is the only tool required; this is held in the right hand between the thumb and forefinger. To get at the organs of fertilization easily, the sack which grows from the side of the column enveloping its front and marking the sexual organs is pressed down by the bit of wood, or this is run through its base, and the sack torn up, or the whole sack may be plucked off with finger and thumb, it matters not how it is laid open, so long as this is done quickly and without injury to any other part of the flower. The smooth end of the fecundating instrument is then laid flat on the front of the column, just beneath the organs of fertilization, and being pushed up, (fig. 12), it catches under the flap which keeps the pollen from coming in contact with the stigma. The flap is raised along with the stick till it lies flat against the upper part of the column, (fig. 13), being held in that position by the bit of wood. The stamen, at first raised along with the flap, now falls down again into its original position, and the flap being out of the way, the pollen comes into contact with the stigma, and a slight pressure of the thumb on the stamen lodges the pollen in the position required, (fig. 15); the bit of stick being then quickly but gently withdrawn, the operation is complete."*

Harvesting. The fruit reaches maturity 6 to 8 months after the flowers are pollinated. The pods become hard, thick, turn greenish-yellow, and a slight bruising sound is audible when the ripe pod is pressed between the fingers. To prevent splitting, pods should be gathered the day they ripen. The pod is taken near the stem-end between the thumb and forefinger, twisted from right to left and pressed aside with the thumb. Attached pieces of flower-stalk are later cut away, but breaks or cracks in the pod itself, rank it as inferior in quality. Pods picked before maturity are deficient in perfume and more subject to fungus growth.

The gathered pods are spread out and exposed to the air for 24 hours. During this time they are sorted as follows: 1, ripe and perfect; 2, unripe but perfect; 3, split; 4, spotted, or, having black points or pieces of flower-stalk attached; 5, curved pods. Attached pieces of flower-stalk must be carefully cut away and black points should be removed. The curing should begin when a sufficient quantity of vanilla has accumulated, as otherwise the pods would split or become mouldy.

Vanilla is prepared for the market in various ways. The best results have been obtained in Mexico. All methods have been carefully studied and the results compared at this Station. A modification of the Mexican method is recommended as a result of these investigations. This method is based on scientific principles, is simple in application, requires but a small outlay for buildings and produces a finished article of superior quality.

* Galbraith, Vanilla Culture; Div. Bot., Bul. 21, U. S. Dept. Agric., 1898, p. 15.

Buildings required. A platform must be constructed. This may be made of stone, coral or cement, should slope slightly towards the south and be protected from the wind by a wall running east and west. This wall should be whitewashed to reflect more heat onto the platform. A drying house must be built. This should be provided with shelves on which the cured vanilla is laid out to dry, also with stands where trays loaded with vanilla may be arranged one above the other. Portable sweatboxes are made of wood. They should be 2 feet deep, 2 feet long and from 16 to 18 inches wide and have a detachable cover. A supply of mats and dark colored woollen blankets must also be provided.

Curing. On a clear warm day, when the platform is dry and warm, mats are spread evenly on the floor of the platform and covered with dark colored blankets. The mats and blankets are previously hung out in the sun. At 9:30 or 10 a. m. the vanilla is spread out quickly and carefully. The first row is started along the wall, the pods laid evenly without touching one another, the stem end farthest from the wall. The pods are left in the sun until thoroughly heated—they should be too warm to be held in the hand. The more quickly the sun heats the fruit and the warmer they get, the better it is. The sweatboxes and dark colored blankets are set out in the sun, and must be warm when the vanilla has reached the proper stage. This should be not later than 2 p. m. The blankets are used as lining and the edges hang over the sides of the box. The heated pods are taken up by handfuls and laid in the boxes, stem end inside, care being taken to put the colored pods at the bottom. The green ones are laid on over these. The box must be filled as quickly as possible, the overhanging blanket edges are covered over the contents and enough warm blankets added on top to competely fill the box. When the cover is securely fastened the box is carried to the drying house and left until the next day. During this time the vanilla turns dark brown and sweats freely. The vanilla remains in the box from 2 p. m. until 10 a. m. The box is then opened, the vanilla examined, spread on the platform and repacked as during the preceding day. This is repeated until sufficiently sweated. This may be accomplished in 4 days, but with unfavorable weather it may require two weeks.

Pods which have remained partly green after the first sweating should be separated, spread out in the sun, the colored parts covered with several thicknesses of white cloth, so as to expose only the green parts to the sun. This is done to cure all parts of the pods equally. Pods which have split during the first sweating are wrapped with thread and the split part covered with white cloth when exposed to the sun.

The sweating having been completed, the vanilla is spread out on trays in single layers. The following days the trays with the vanilla are set out in the sun for a few hours and otherwise dried in the shade. The last drying is done only in the shade, and the trays are covered with cheesecloth to keep off the dust. Fully dried vanilla is packed in tin boxes and coveerd with cloth.

The finished article has a well developed aroma, feels dry but pliable and has a dark brown color. After remaining in the tin boxes for several weeks, the vanilla is classified and put up in bundles. These bundles are packed in tin boxes, which are lined with oiled paper of correct dimensions. One month later these boxes are opened, carefully examined, damaged packages removed, opened and cared for,

good packages of the same size substituted, the boxes closed, soldered and labelled.

To provide against loss during rainy weather, the sweating must be accomplished by artificial heat. Good results can be obtained by the use of a bake oven or coffee-drying house. The vanilla is put up in packages of certain size and shape and wrapped in woollen blankets and mats to prevent overheating. The drying can be completed in a heated drying house.

The sorting, curing, drying, classifying and packing must be done by an experienced man. A well equipped central curing establishment with an experienced foreman would, therefore, be very desirable from an economical point of view.

Yield. This has never been properly ascertained in Hawaii. The wild vanilla plant of Mexico bears one, two and rarely five pods, all of superior quality. Two cultivated and hand pollinated plants at Moanalua, Oahu, produced 300 pods in 1902, and 150 pods in 1903, about one-fourth being of good size and quality. This only indicates what may be accomplished by cultivation, but is neither practicable nor advisable on a large plantation. Plants yielding a very heavy crop may become exhausted. The roots, and sometimes the stalk, rots away or the vines turn yellowish green, the leaves become soft and white, the tendrils dry and the whole plant dies. A yield of 10 pods for ordinary and 20 or even 25 pods for strong, healthy plants should be a safe limit. One a basis of 10 pods per plant, 2 plants to each support, and 680 supports per acre, a yield of 13,600 pods would be secured. One thousand average good pods weigh 45 pounds, and dry to half their volume and about one-fifth their weight during the curing process; 13,000 pods weigh 585 pounds, and the finished article about 120 pounds. At least one-half of this should be of superior quality and sell for from $6 to $9 per pound, f. o. b. Honolulu. The balance would bring from $1.25 to $4 per pound. This would give a return of not less than $435 per acre. This, however, can only be accomplished when a fair portion of the finished article is of superior quality.

Diseases. All the vanilla reported to be growing on these islands has been inspected by an expert of this Station and found free from fungus or other diseases, as well as from the various insect pests which affect this plant in other countries. Should any of them make their appearance, planters are requested to at once notify this Station, giving particulars and mailing a specimen of vine affected.

More detailed information in regard to the cultivation, curing and classifying of vanilla will be given in a bulletin which will be issued by this Station whenever the growth of the industry demands it.

FRANK E. CONTER, Assistant.